Catalunya in GPM GV

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Amb l'acreditació de:

Generalitat de Catalunya
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GRAHI

UPC

Grup de Recerca Aplicada en Hidrometeorologia
UNIVERSITAT POLITÈCNICA DE CATALUNYA

Where is Catalunya?

Catalunya and its characteristics

Catalunya is
a good representative of Mediterranean regions

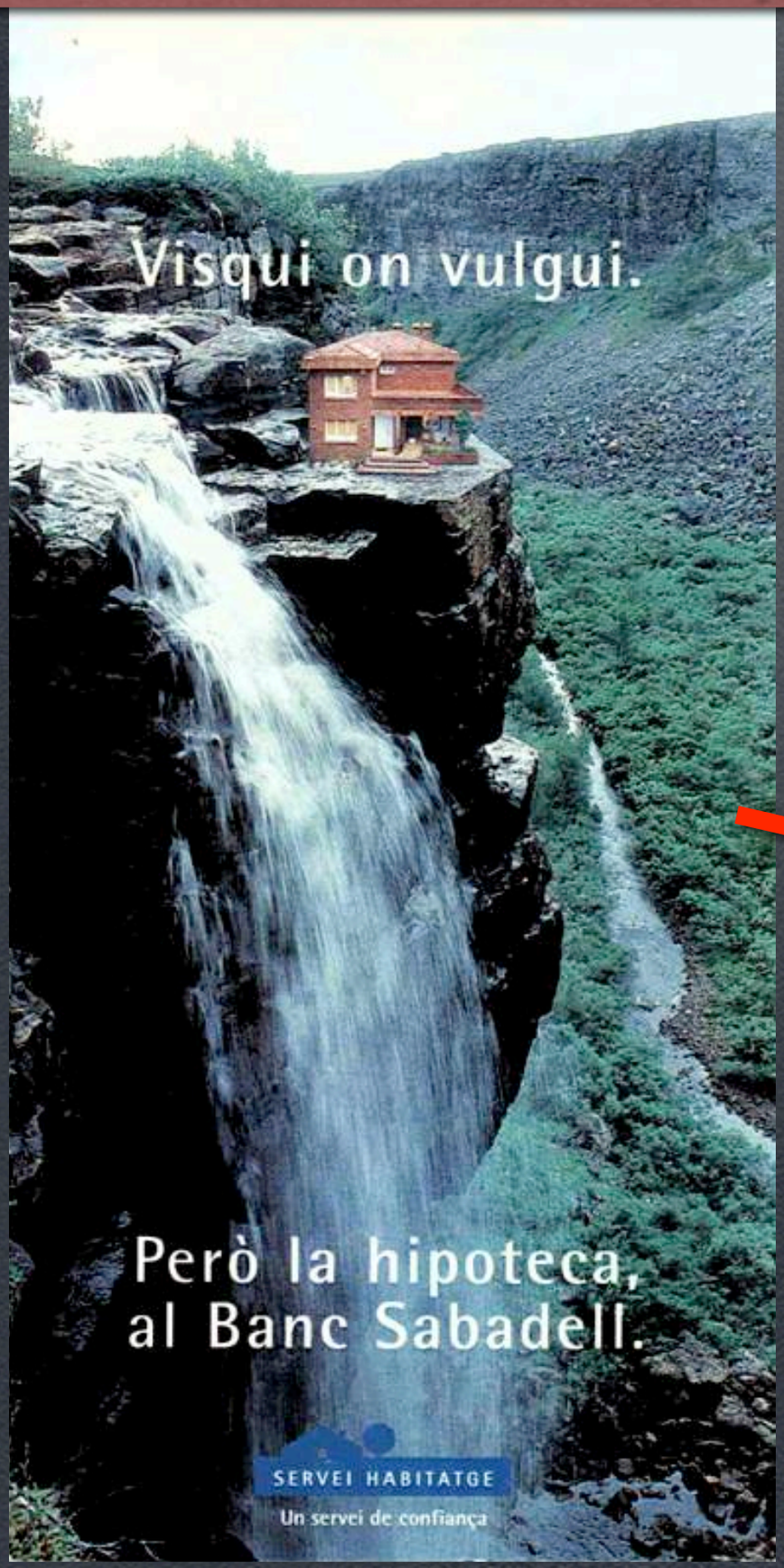
- Climate characterized by events of **heavy rain** with **high spatial and temporal variability**
- Driven by the interaction between **marked orography and a warm sea**

- Mean yearly precipitation between 300 and 700 mm
- Daily maximal precipitation: 1200 mm/day
- 10-year return period daily precipitation > 100 mm
- Daily precipitation > 200 mm → 3 days/year somewhere

Catalunya and its characteristics

- One of the **major urban areas on the Mediterranean: Barcelona** (over 3 millions inhabitants)
- One of the **most touristic areas of the world**
- **High sensitivity to floods** (only on the Llobregat river basin **46 damaging floods from 1780)**
- **Wide social interest** for precipitation measurements and forecasting

Catalunya and its characteristics



Urbanisation has occupied the flood prone areas

Advertisement:

Locate your house wherever you want... But the loan do it at our Bank

Catalan National Network

Operational instrumentation at Catalunya

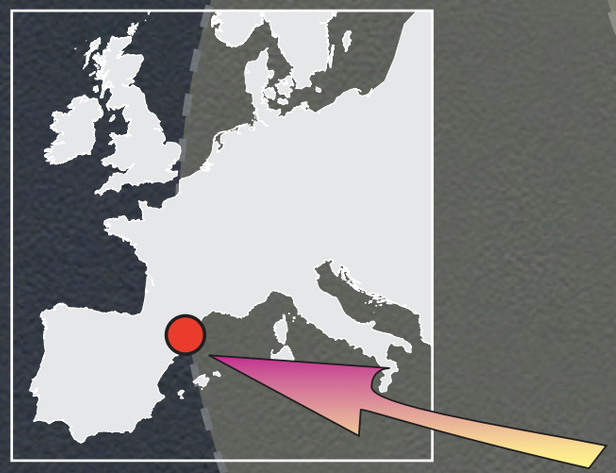
SAIH telemetered network

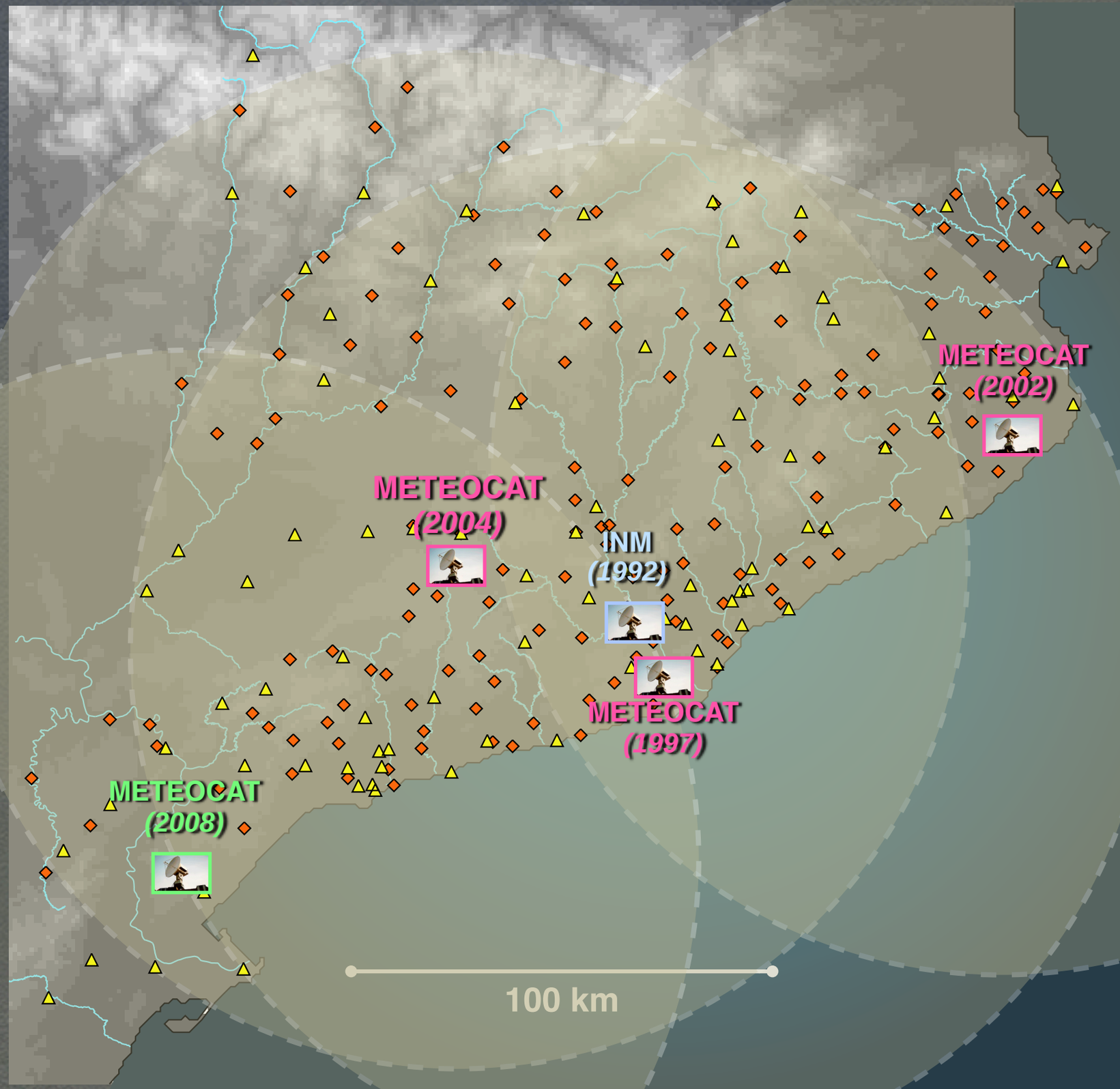
- *stage level*
- *raingauges*

METEOCAT network

- *raingauges*

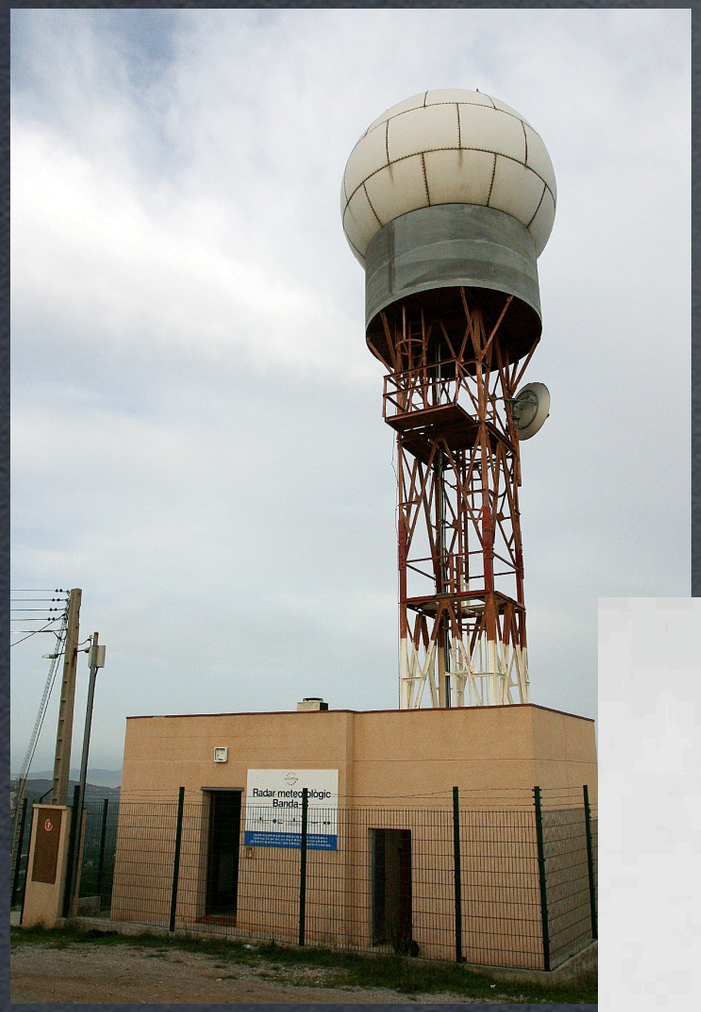
C-band, Doppler Radar network





Catalan National Network: RADARS

Vallirana (1997)



Puig d'Arques (2002)

Creu del Vent (2004)

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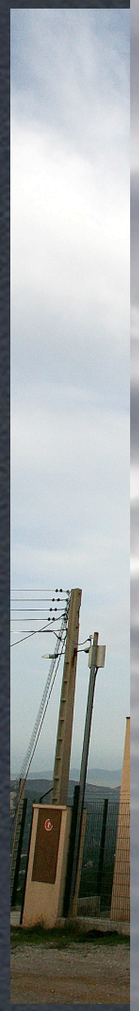
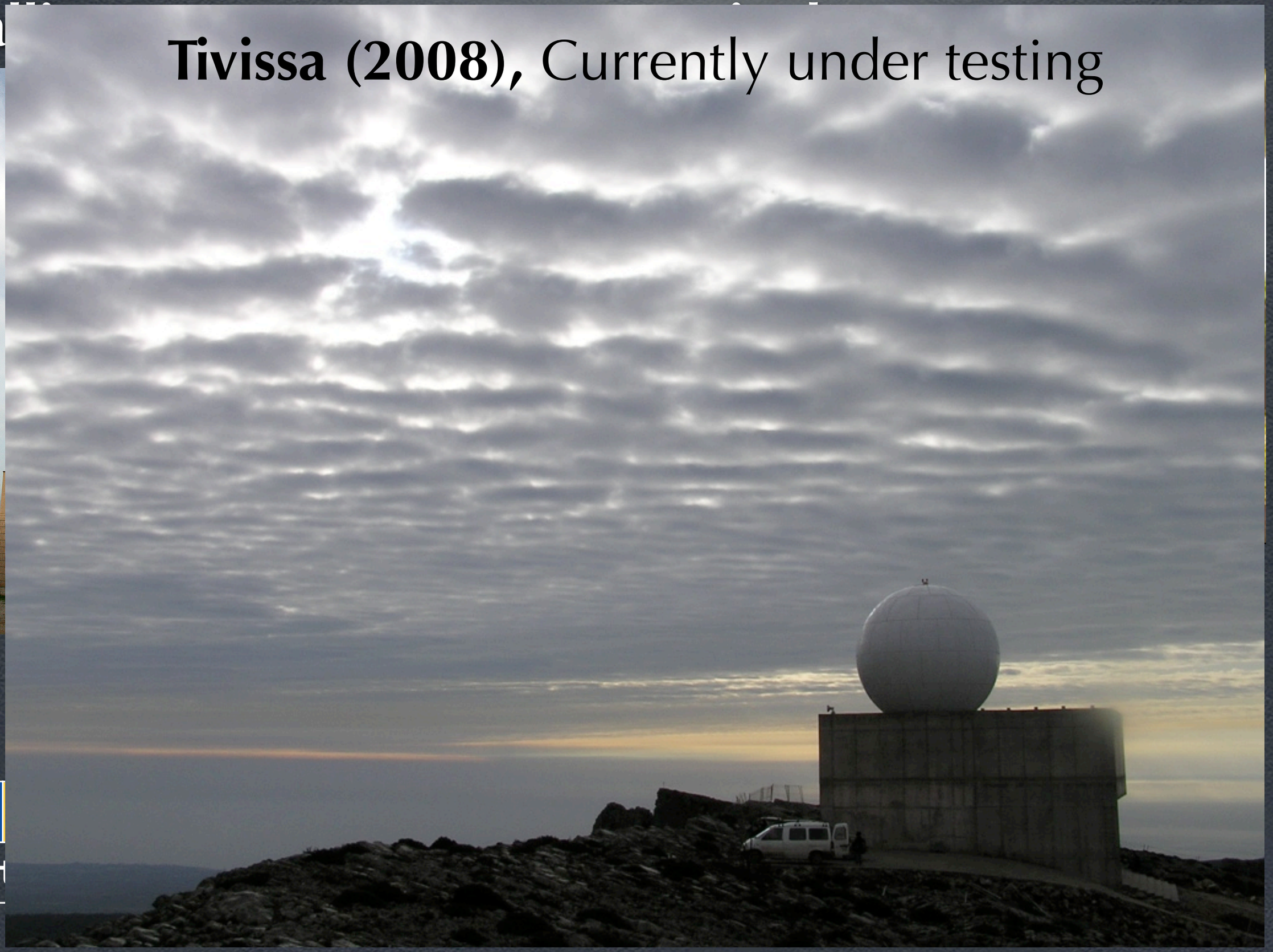
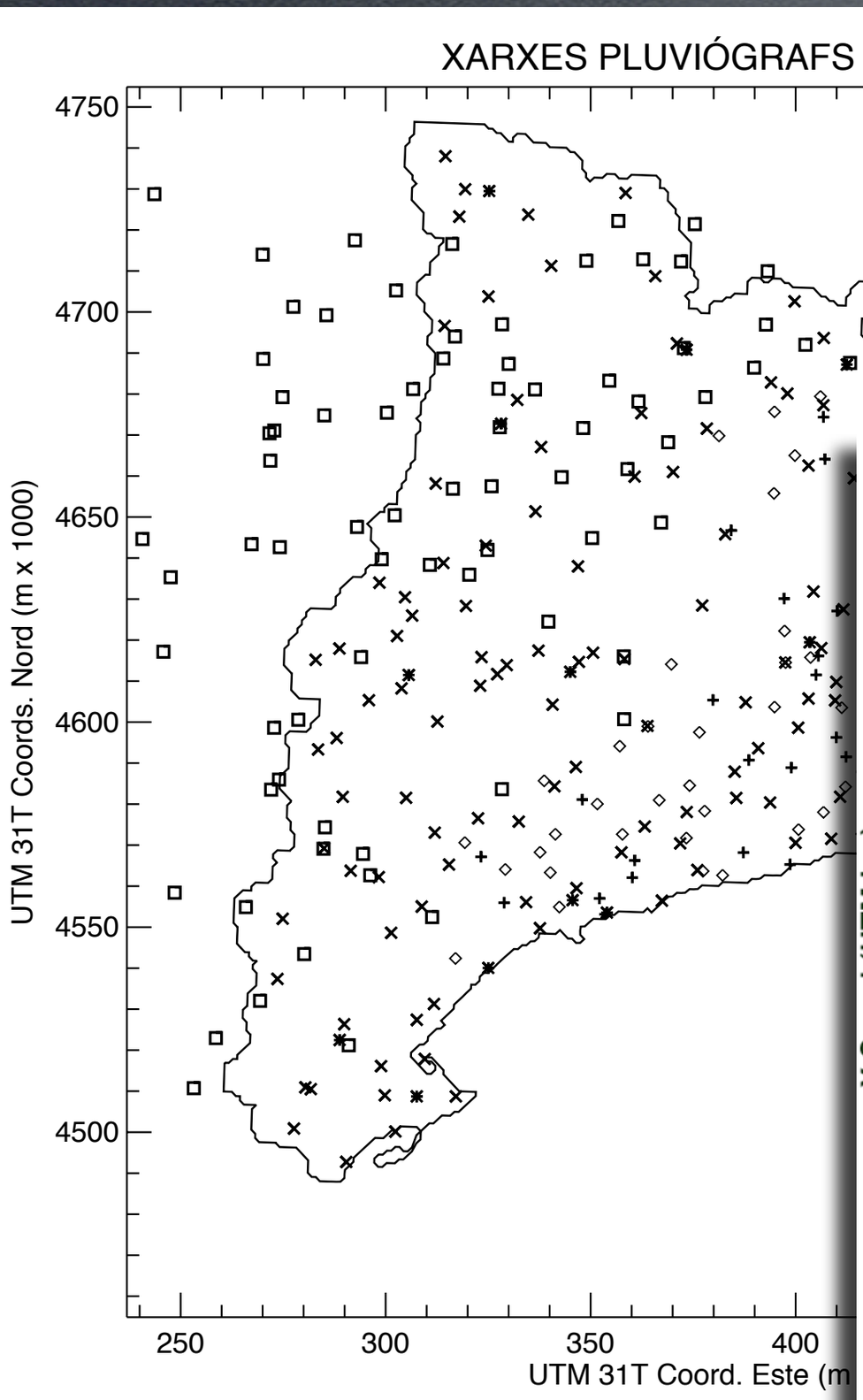
Catalan National Network: RADARS

Tivissa (2008), Currently under testing

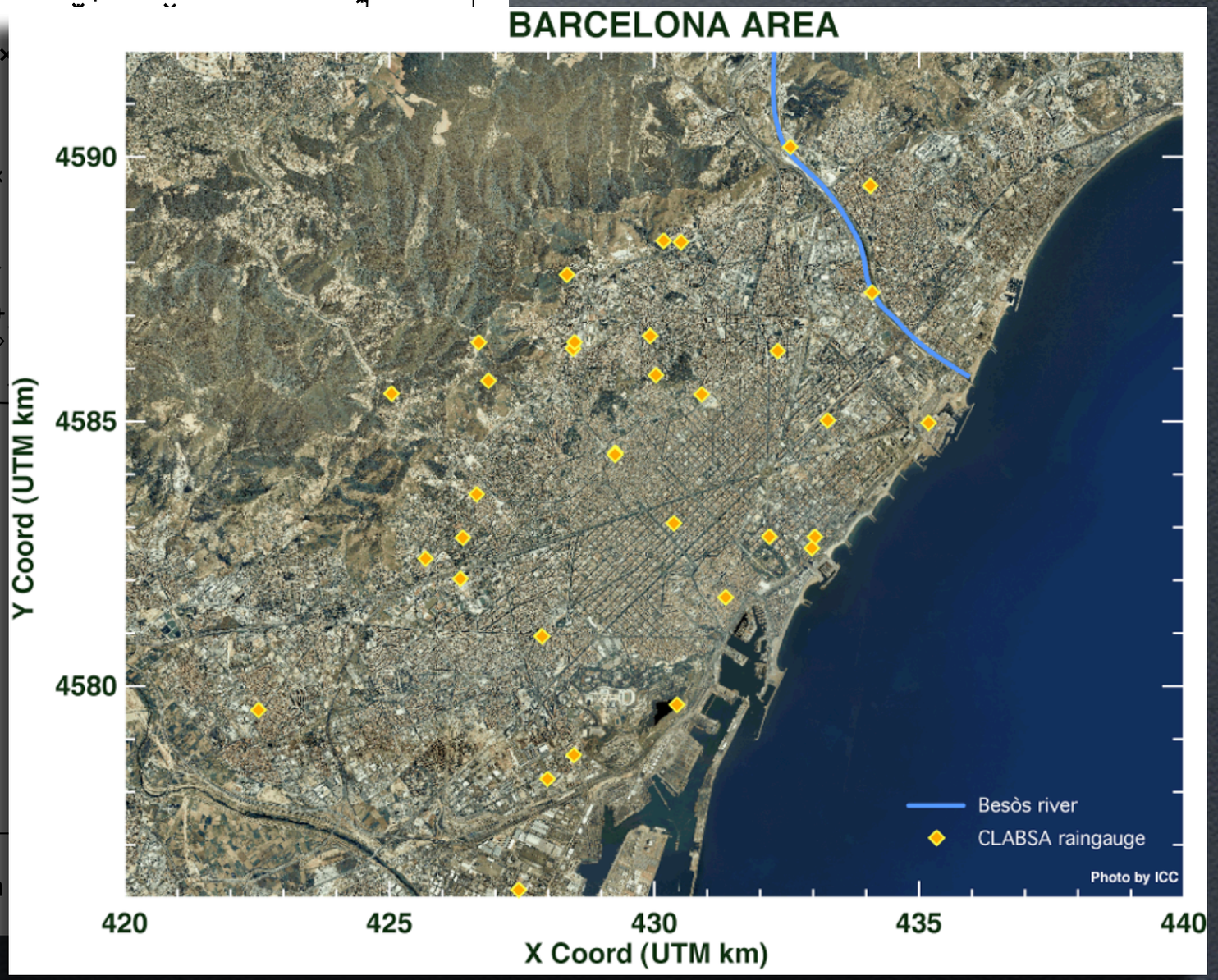




Catalan National Network: RAINGAUGES



390 automatic (~10 min) Considering all networks



Research Topics at GRAHI-UPC

- Hydrometeorological data correction chain and product generation: **QPE**.
- Precipitation forecasting: **QPF**.
- **Rainfall-Runoff models** and hydrological forecasting.
- **Visualization** and **analysis tools** for hydrometeorological data.
- Study of the **error structure** in **radar estimates**. Ensemble techniques.

Error structure in radar estimates

Based on: Compare radar estimates against a **Benchmark**

Sempere-Torres, AMS2007; HAWR2008

Benchmark: The BEST 2D precipitation field estimate we are able to obtain

- Using all the existing information (sometimes not available in real time)
- Allowing post-processing
- Allowing expert analysis

Error structure in radar estimates

RAW

Signal and groundclutter processing

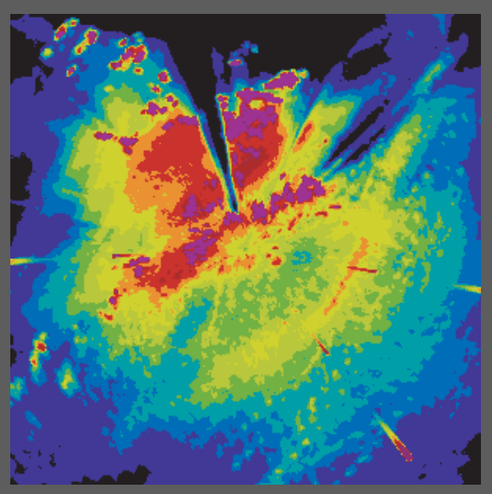
Stage 2 Corrected data

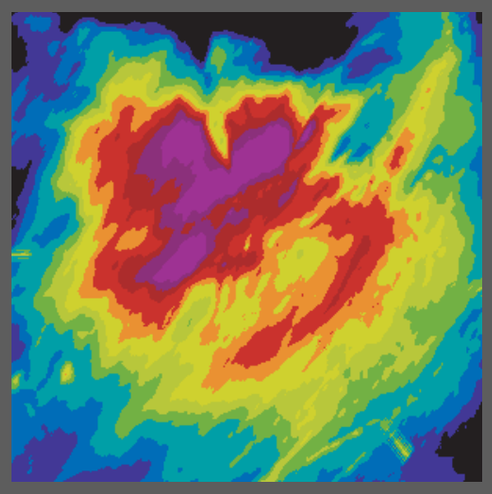
Precipitation type classification VPR and Z-R per types

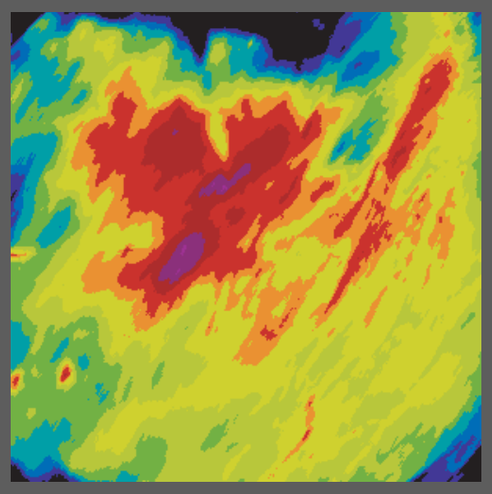
Stage 3 R at ground

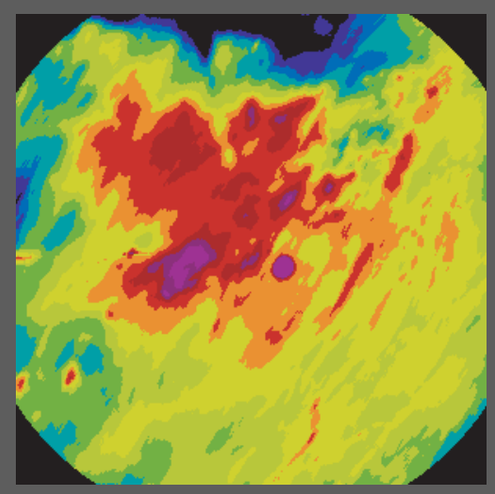
Finest Raingauges Blend

Stage 4 Refinement









Rain accumulation for a whole event

Error structure in radar estimates

Based on: Compare radar estimates against a **Benchmark**

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Benchmark: The BEST 2D precipitation field estimate we are able to obtain

- Using all the existing information (sometimes not available in real time)
- Allowing post-processing
- Allowing expert analysis

Error definition:

$$Error = 10 \cdot Log_{10}\left(\frac{Benchmark}{RadarData}\right)$$

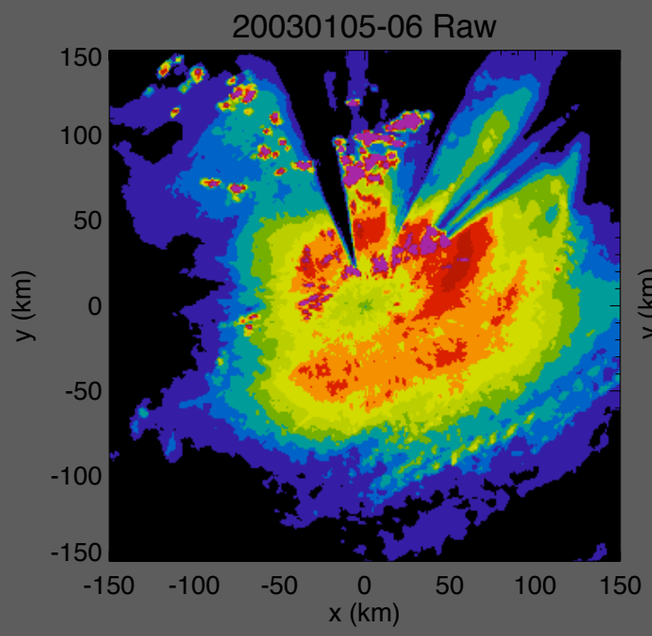
Error structure in radar estimates

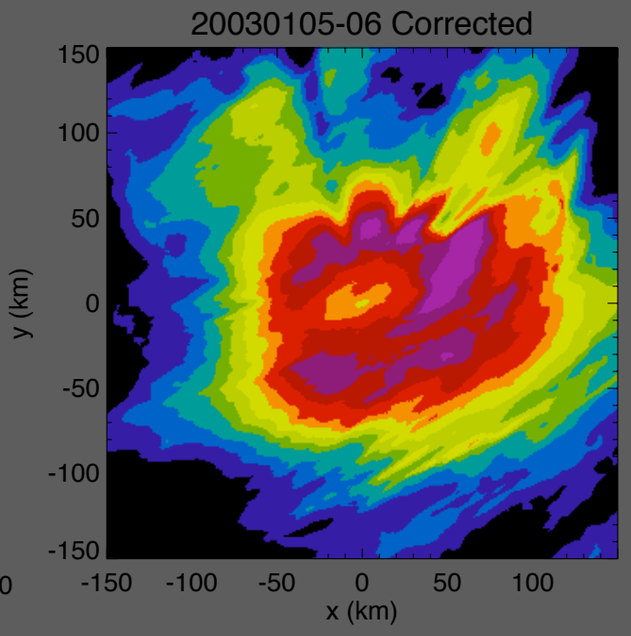
Ba

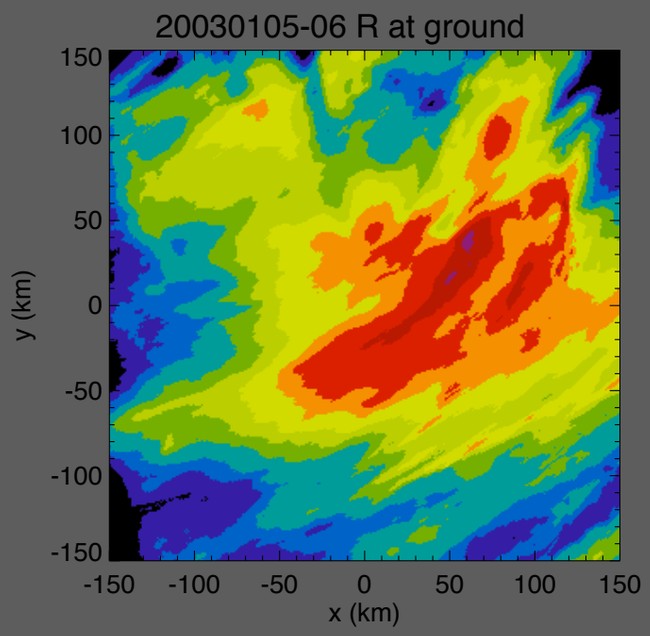
Be
ab

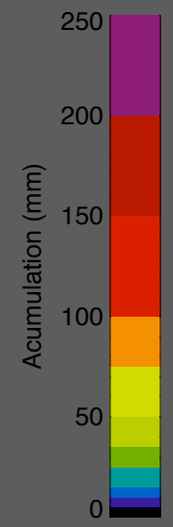
Er

Accumulation

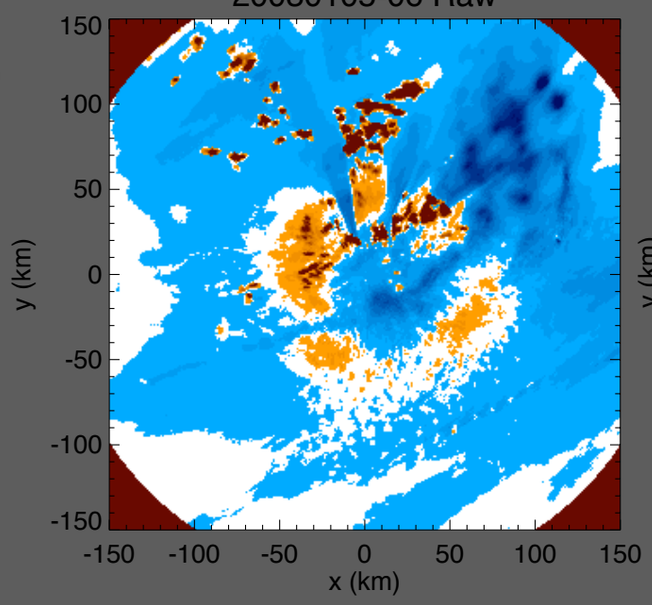


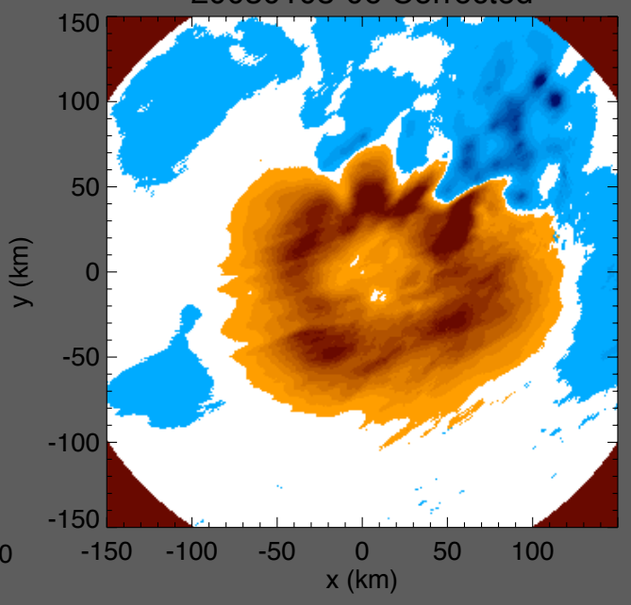


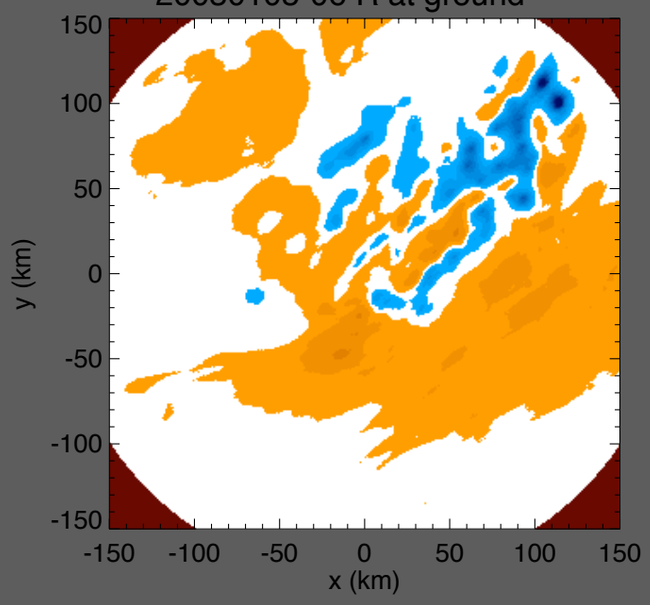


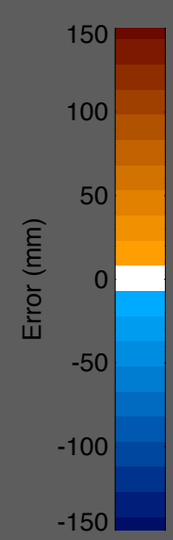


Additive Error









Raw Corrected At ground

Error structure in radar estimates

Based on: Compare radar estimates against a **Benchmark**

Sempere-Torres, AMS2007; HAWR2008

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- Using all the existing information (sometimes not available in real time)
- Allowing post-processing
- Allowing expert analysis

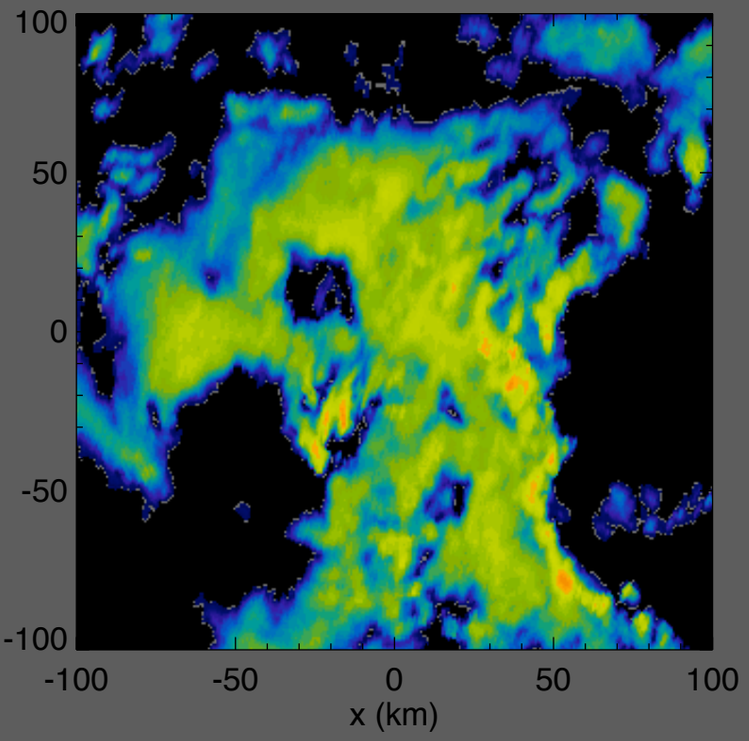
Error definition:

$$Error = 10 \cdot Log_{10}\left(\frac{Benchmark}{RadarData}\right)$$

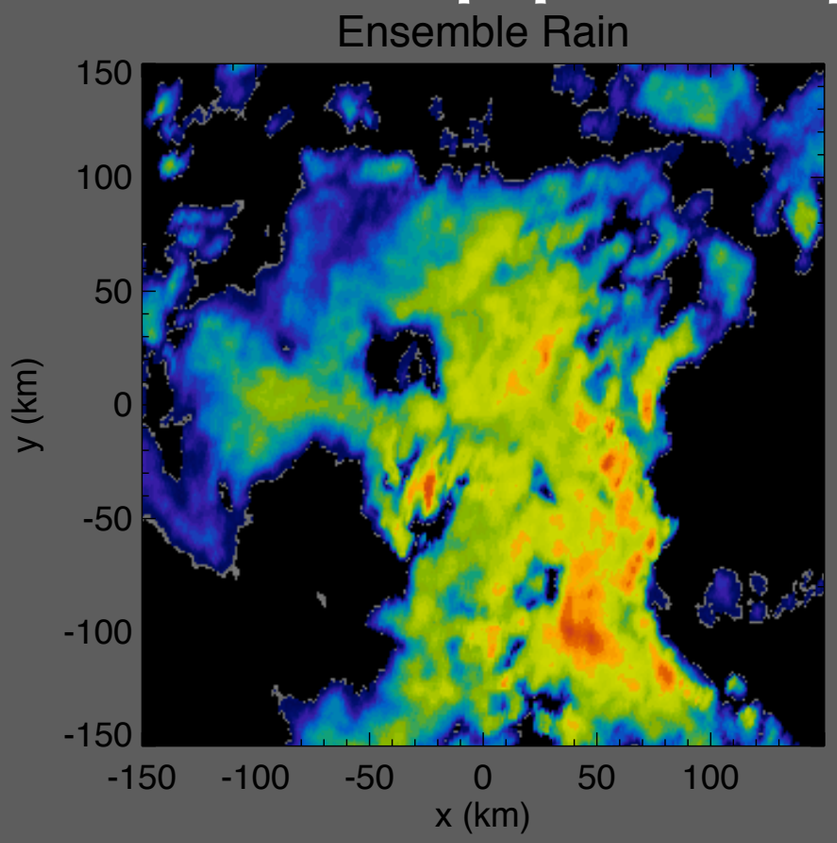
Generation of **radar ensembles** using the obtained error characteristics

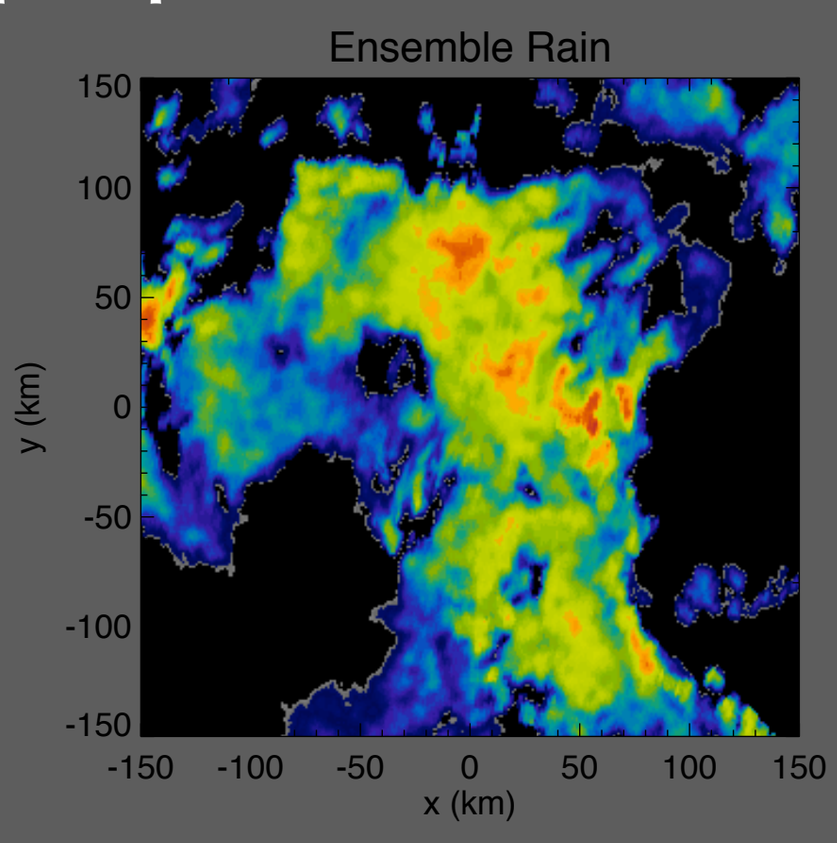
Error structure in radar estimates

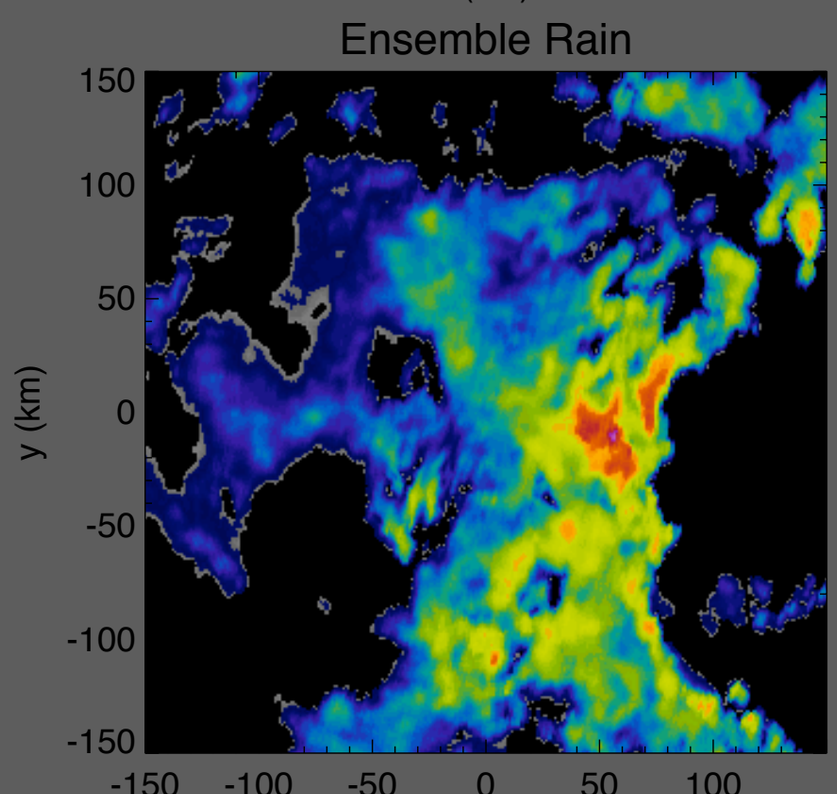
Observed

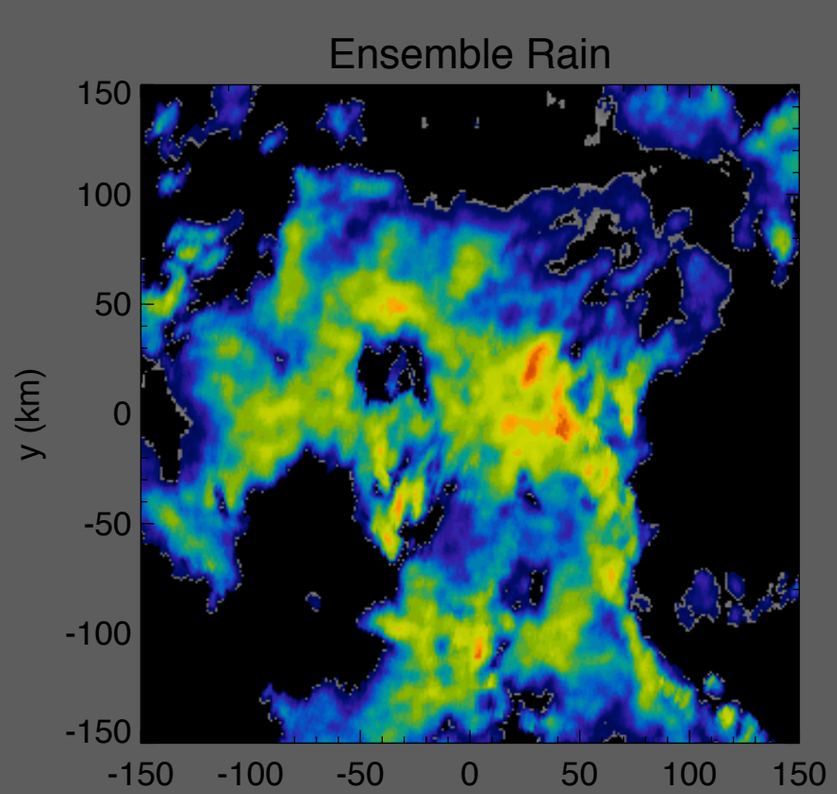


4 equiprobable precipitation fields



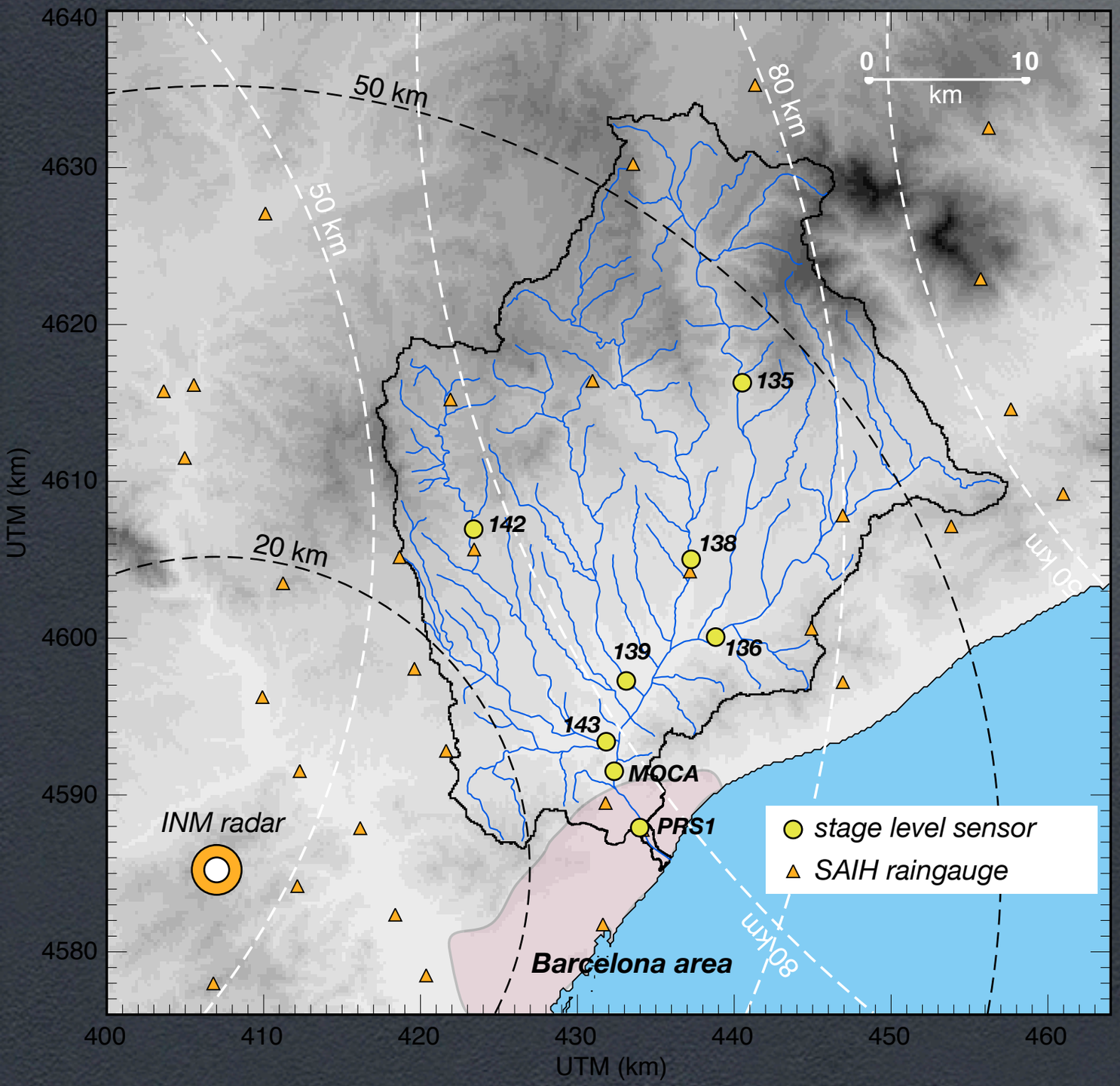






Hydrological validation: Besòs TestBed

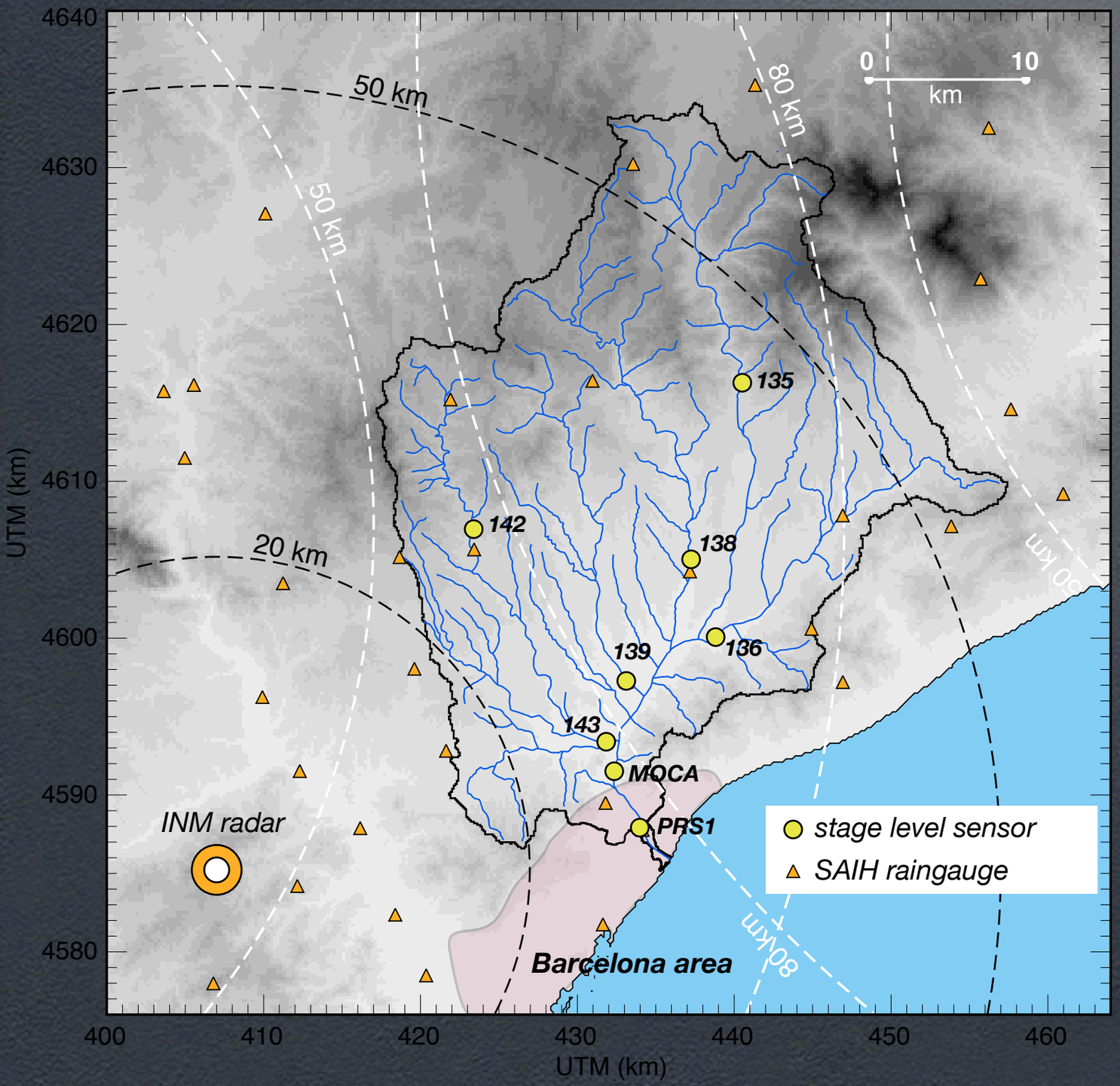
Besòs basin (1015 km^2)



- Elevations: 0-1400m asl
- High urbanization degree
- Under the umbrella of 4 radars at distances below 100 km

Hydrological validation: Besòs TestBed

Besòs basin (1015 km^2)



- Elevations: 0-1400m asl
- High urbanization degree
- Under the umbrella of 4 radars at distances below 100 km
- **Real-time validation** using **Dichitop** Rainfall-runoff Model

Hydrological validation: Besòs TestBed

The rainfall-runoff model Dichitop (Corral, 2004)

- **Grid-based model** able to use distributed rainfall fields.
- A lumped model is applied at **hydrological cell** scale.
- TOPMODEL in rural cells and SCS in urban cells.
- A **simplified drainage network** is used to transfer cell hydrographs.
- **Basin hydrograph** is calculated as the linear combination of cell hydrographs.

Reseach Projects and Partnerships

Range

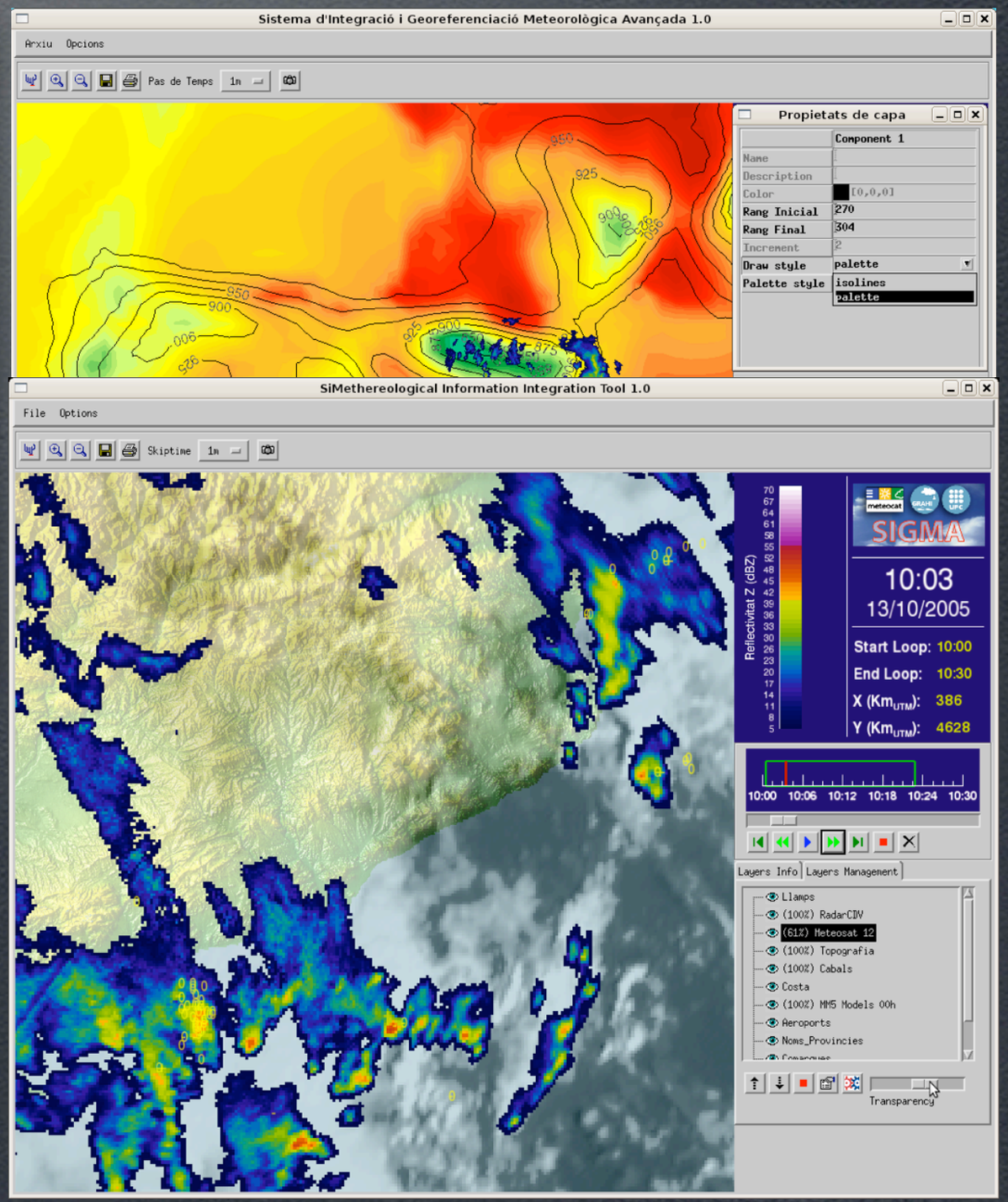
Catalunya

Spain

EU

SIGMA: Integrated Visualization tool

- **Radar Products**
- **MeteoSat Products**
- **Georef. Information**
- **NWP Models**
- **Lighting**



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Reseach Projects and Partnerships

Range

Catalunya

EHIMI (2002-2006)
Integrated System for HydroMeteorological Forecasting in Catalunya

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Reseach Projects and Partnerships

Range

Catalunya

Spain

EU

EHIMI (2002-2006)
Integrated System for HydroMeteorological Forecasting in Catalunya

- The main purpose of the EHIMI project was to implement a **real-time hydrometeorological forecasting system** based on weather radar information.
- EHIMI is composed by **several modules and tools** oriented, on one hand, to **process and analyze 3-D radar data**, and in the other hand, to process the **conventional hydrological data** (raingauges and stage sensors), obtaining an **improved rainfall field** based on a radar-raingauge blending.
- EHIMI uses also a **rainfall forecast**, followed by the application of a distributed **rainfall-runoff model** (Dichitop), providing helpful information in order to manage floods in risky situations.

Reseach Projects and Partnerships

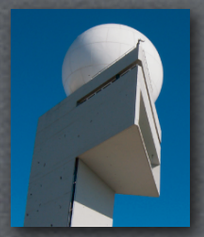
EHIMI (2002-2006)

Radar Data

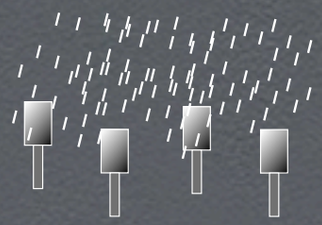
PBE

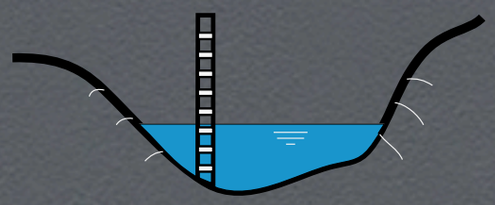
CDV

PDA



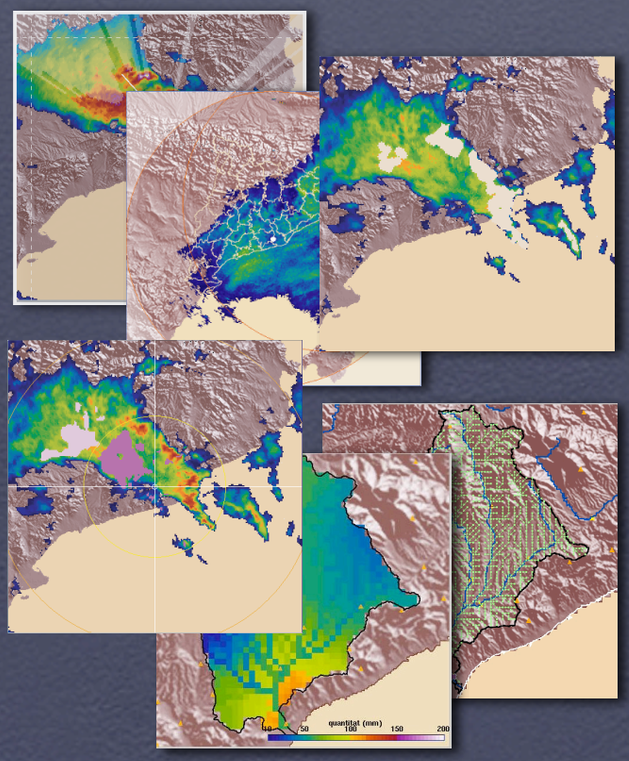
Hydrological Data



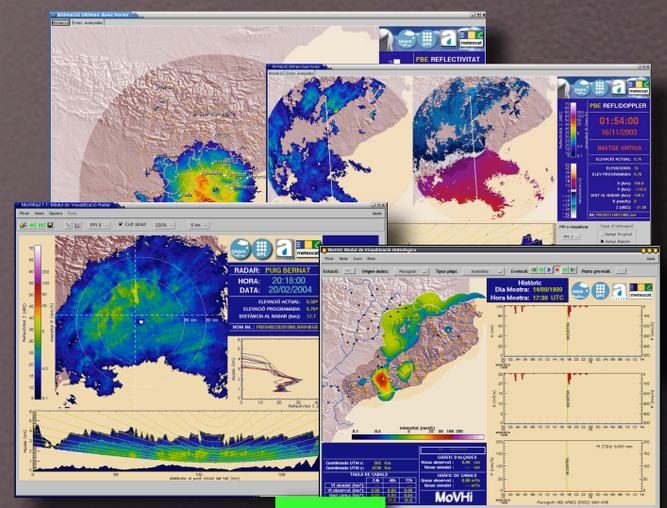


Data Correction

Product Generation



Dissemination & Visualization

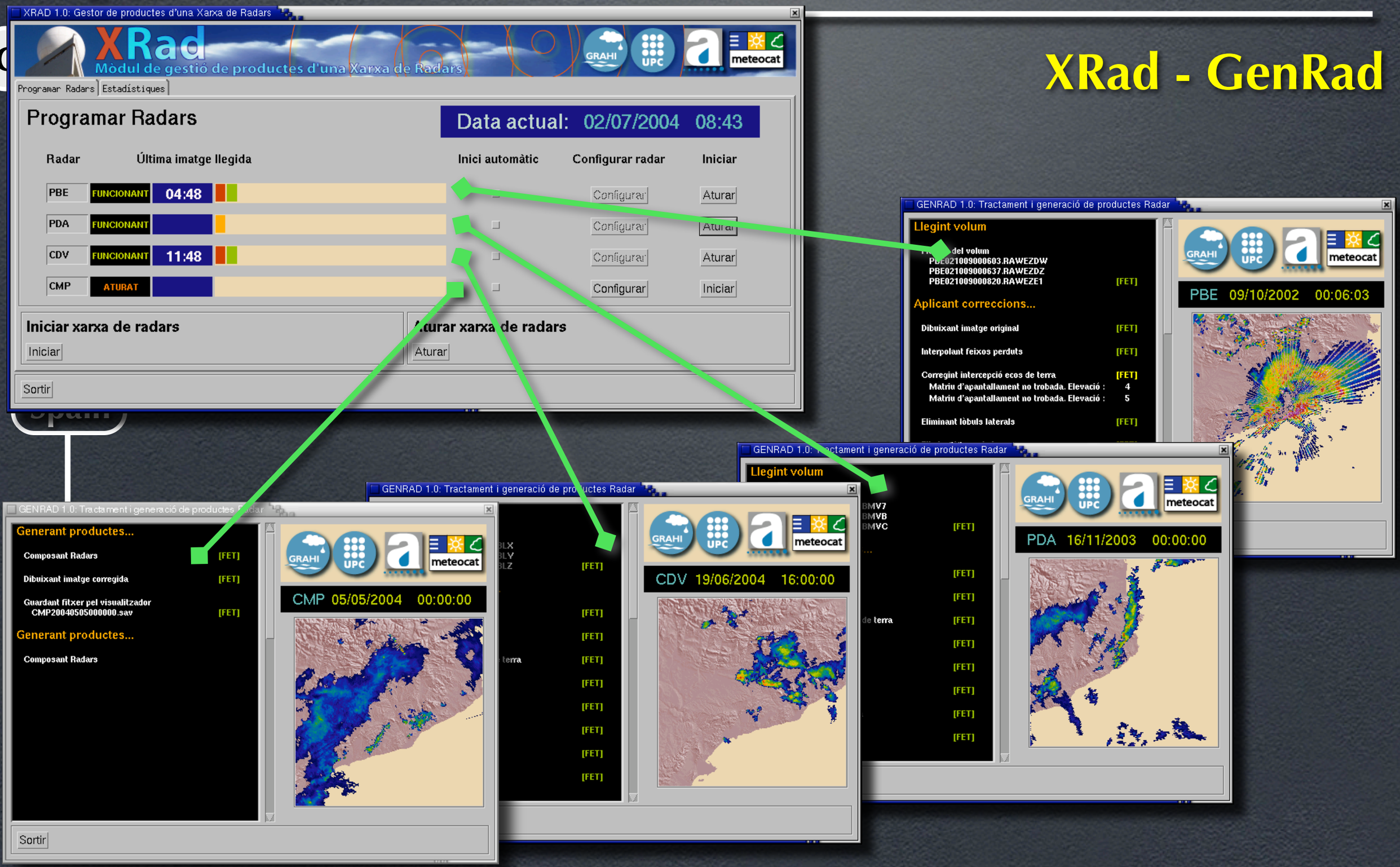


Reseach Projects and Partnerships

Range

EHIMI (2002-2006)

XRad - GenRad



Reseach Projects and Partnerships

Range

Catalunya

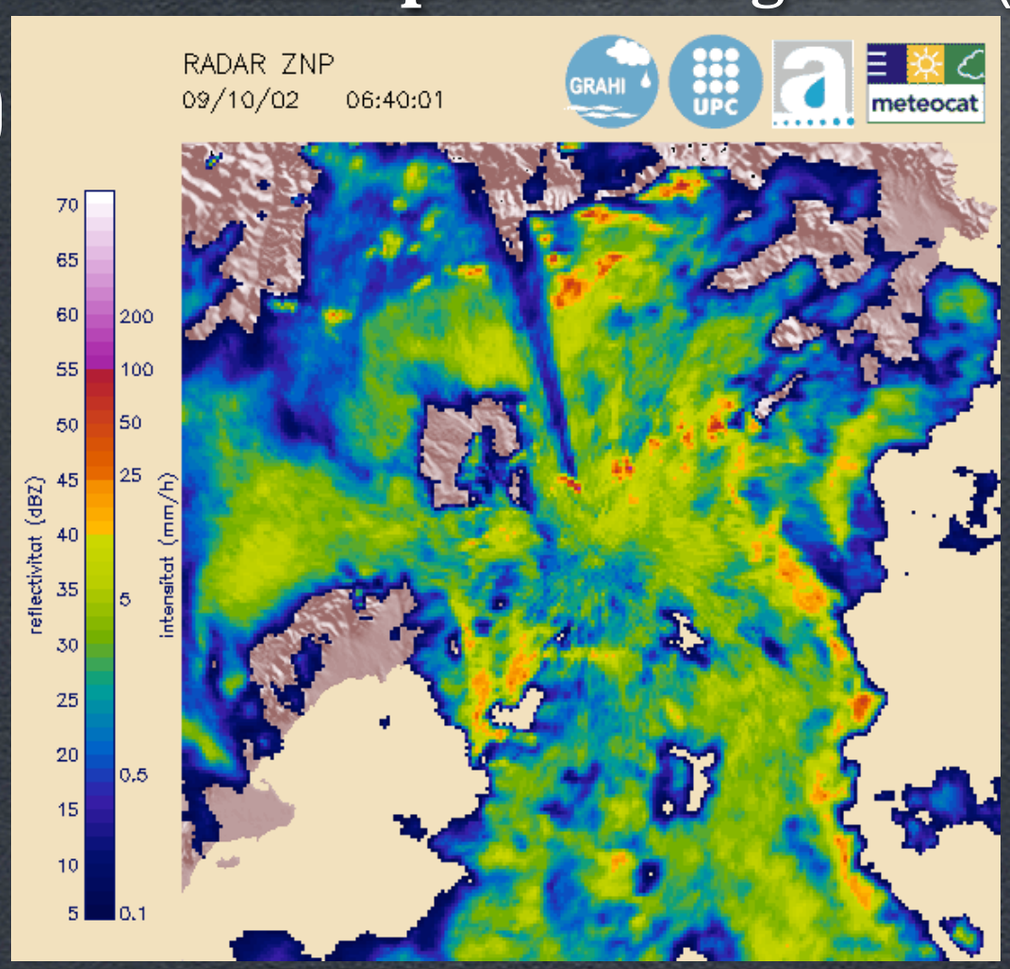
Spain

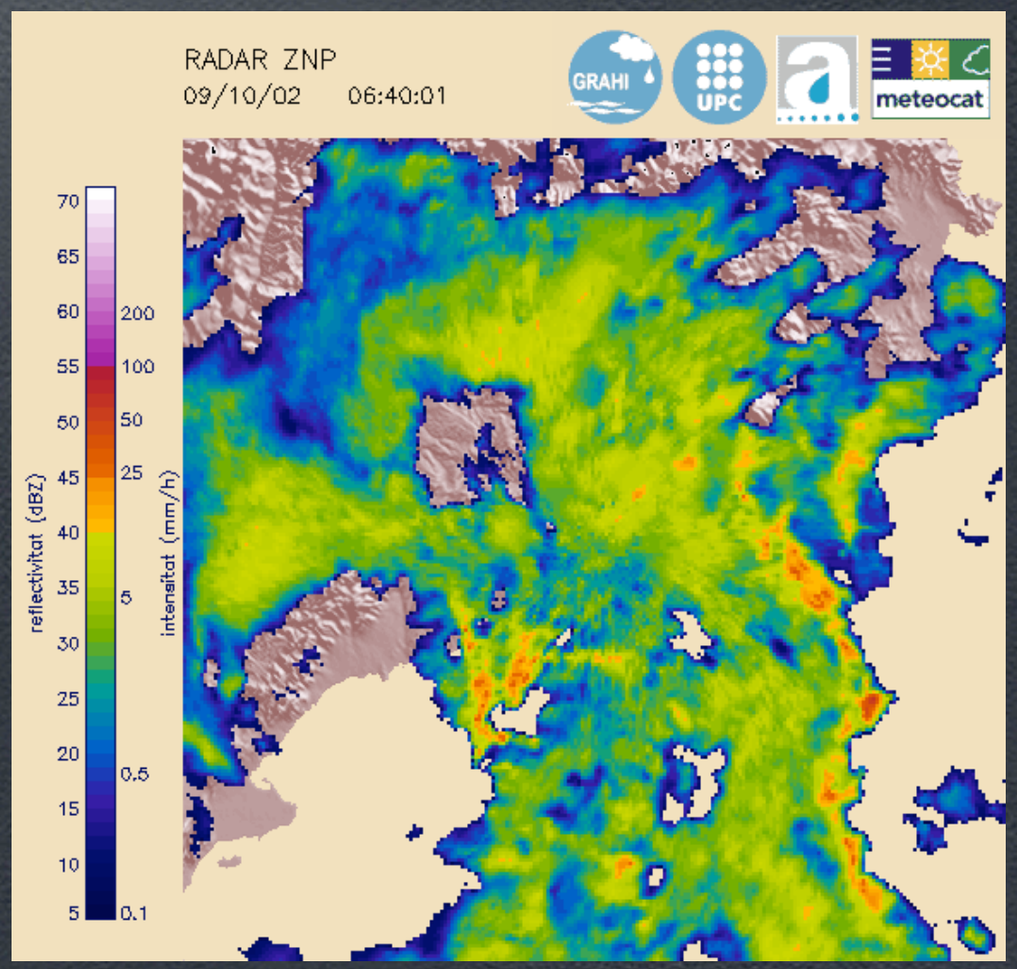
EU

EHIMI (2002-2006)

- Stability
- Screening effects
- Ground clutter suppression and substitution
- Attenuation
- Extrapolation to ground (VPR)

GenRad





Reseach Projects and Partnerships

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EHIMI (2002-2006)

Catalunya

Spain

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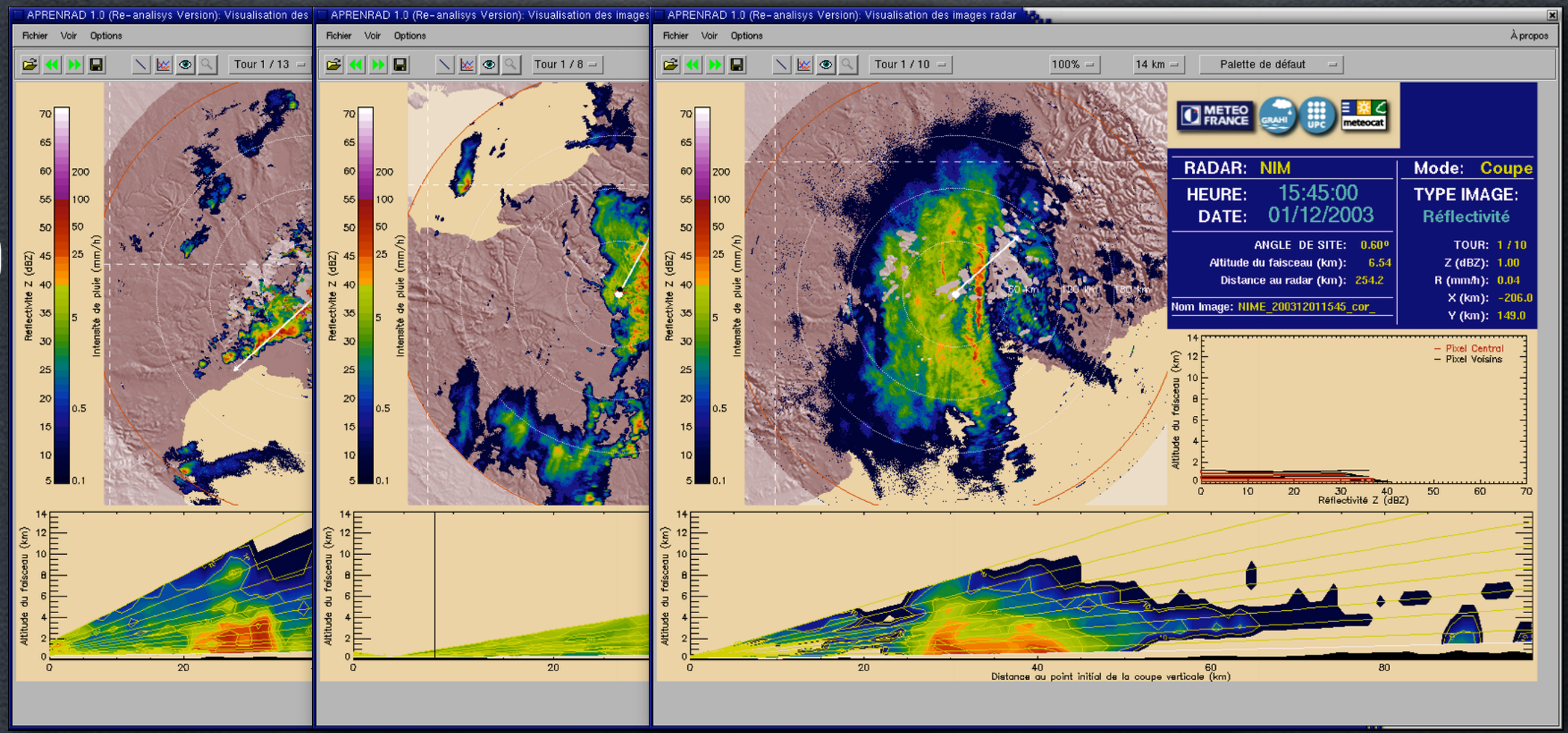
MoViRad



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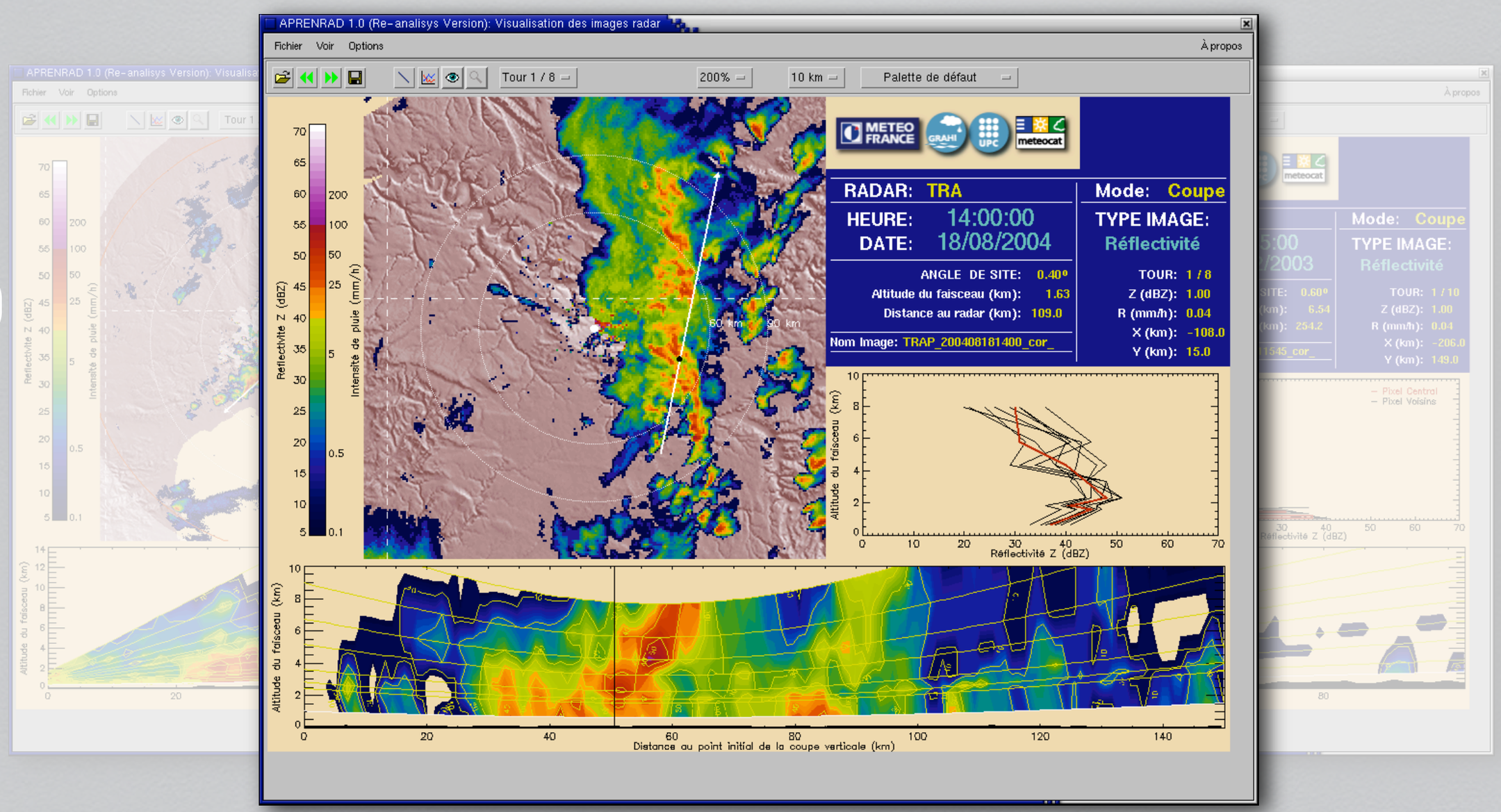

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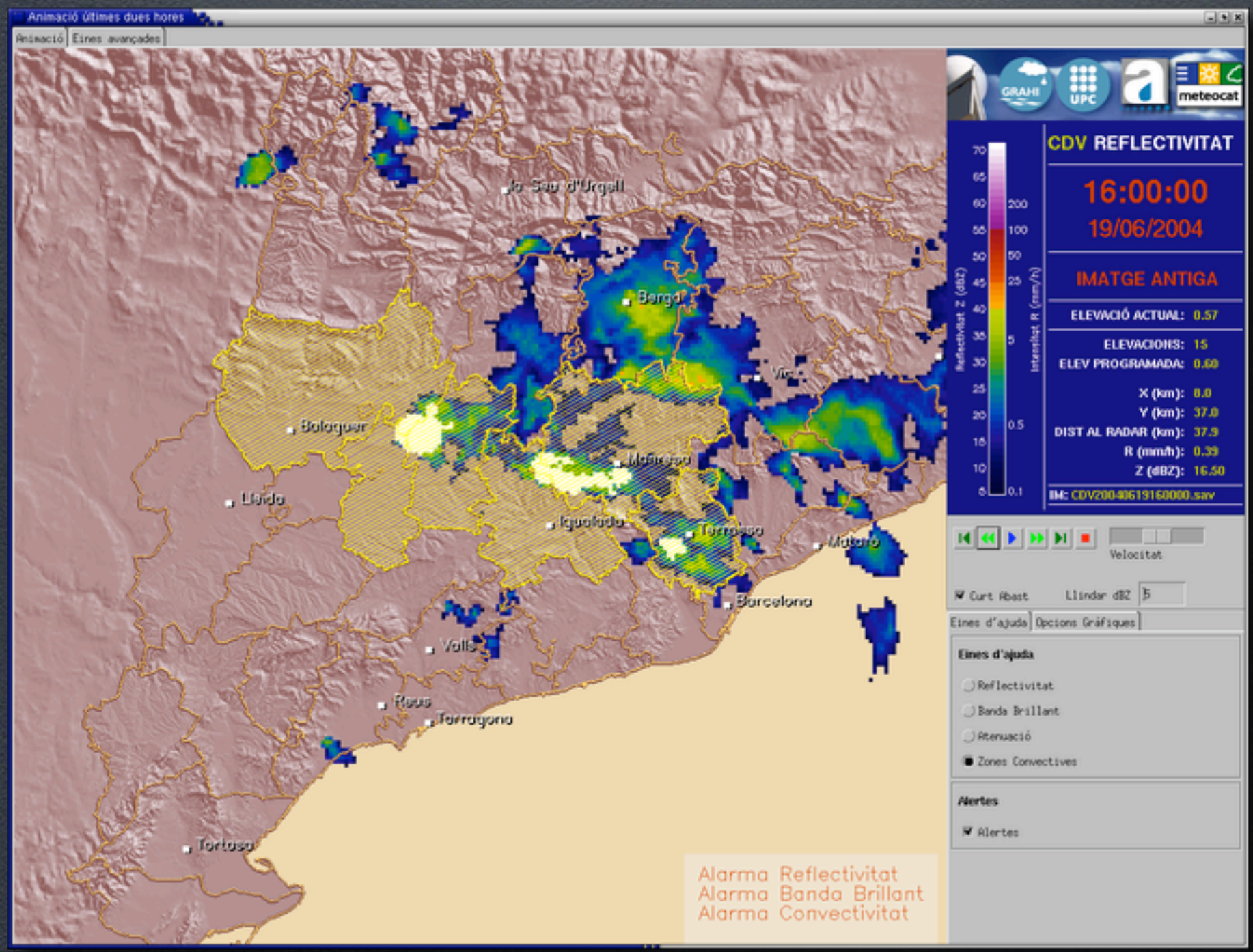
EHIMI (2002-2006)

AniPRad



Reseach Projects and Partnerships

Range

Catalunya

Spain

EU

EHIMI (2002-2006)

Integrated System for HydroMeteorological Forecasting in Catalunya

EHIMI - Phase II (2007-2010)

- **Improvement** of the Integrated Hydrometeorological System (**radar data correction, raingauge merging, radar based nowcasting, rainfall uncertainties estimation**)
- **Extension** of the FF **early warning system** to all catalan territory, based on high resolution hydrologic forecasting

Reseach Projects and Partnerships

Range

TELVENT - EGMASA - INM (2007-2008)

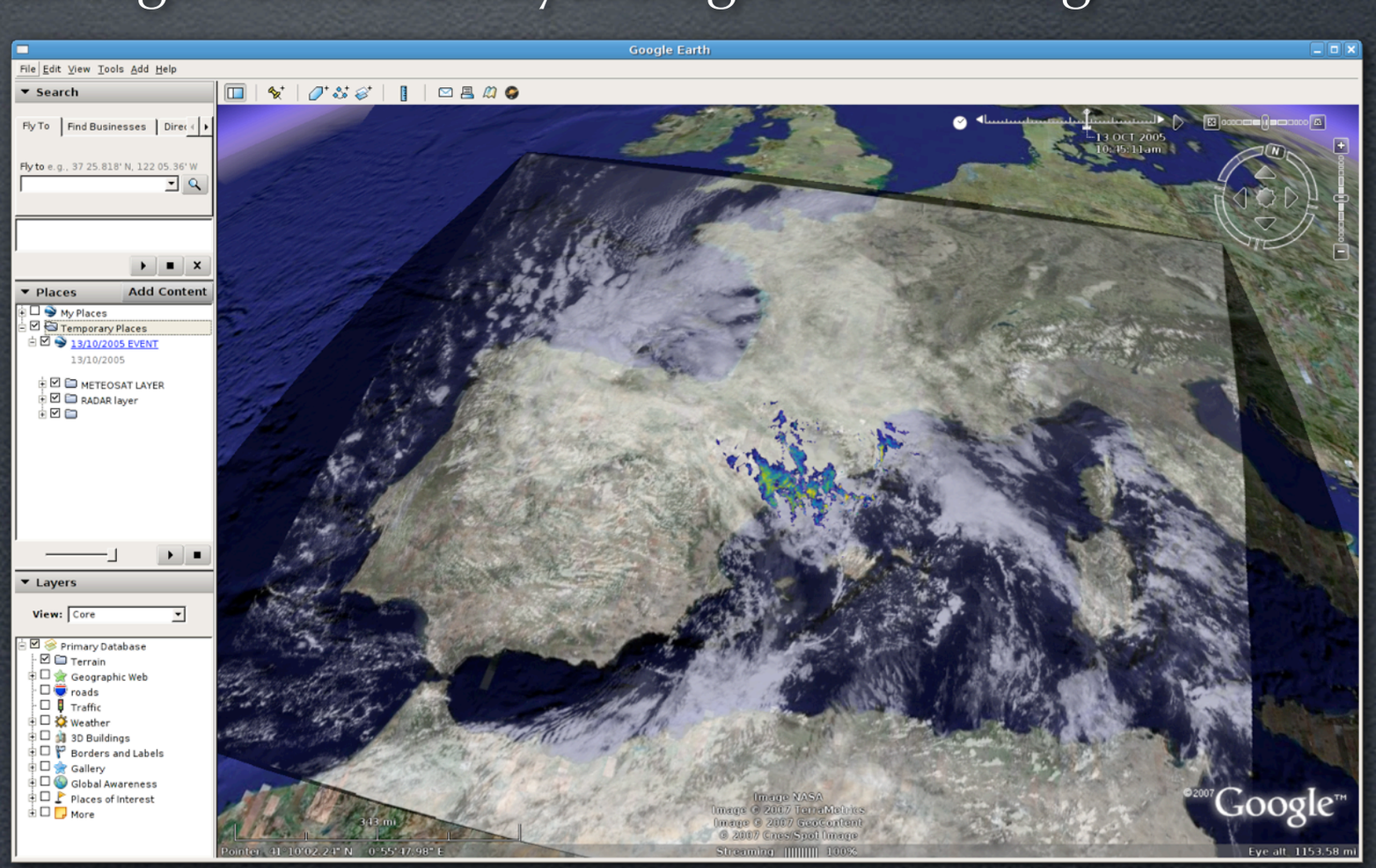
Catalunya

Spain

EU

- Implementation of an **Integrated Hydrometeorological System** (radar correction, raingauge merging) in Andalucia
- Radar data provided by INM radar network
- Implementation of the **FF early warning system** to 2 watersheds in Andalucia, based on high resolution hydrologic forecasting

Visualization integrated in G-Earth



Reseach Projects and Partnerships

Range

Catalunya

Spain

EU

FLOODsite (2004-2009)

Integrated Flood Risk Analysis and Management Methodologies

FLOODsite

SIXTH FRAMEWORK PROGRAMME

- 'Global Change and Ecosystems' Program (6th EU Framework Program, **FP6**)
- The FLOODsite Project Team comprises some **37 partner** organisations drawn from **13 different countries**
- FLOODsite aims to deliver **tools and methodologies** to support integrated **flood risk analysis and management**.
- **Seven Pilot Study Sites** have been established within FLOODsite (being subject to flash floods). The purpose of the Pilot Sites is to provide real locations with real problems that participate as an integrated part of the research and development work.

Reseach Projects and Partnerships

Range

Catalunya

Spain

EU

HYDRATE (2006-2009)

Hydrometeorological data resources and technologies for effective flash flood forecasting

- STREP Project of the 6th EU Framework Program (**FP6**)
- The HYDRATE Project Team comprises **9 universities and 7 government research centres.** These represent 8 Member States, 1 Associated Candidate State and 3 third-countries (**12 Countries**)
- The HYDRATE objective is to **improve** the **scientific basis of flash flood forecasting**, advancing a European-wide innovative flash flood observation strategy and developing a coherent set of technologies for effective early warning systems
- HYDRATE will develop a **freely-accessible European Flash Flood Database** to make available the collected hydrometeorological data to the international research community.

Reseach Projects and Partnerships

Range

Catalunya

Spain

EU

HYDRATE (2006-2009)

Hydrometeorological data resources and technologies for effective flash flood forecasting

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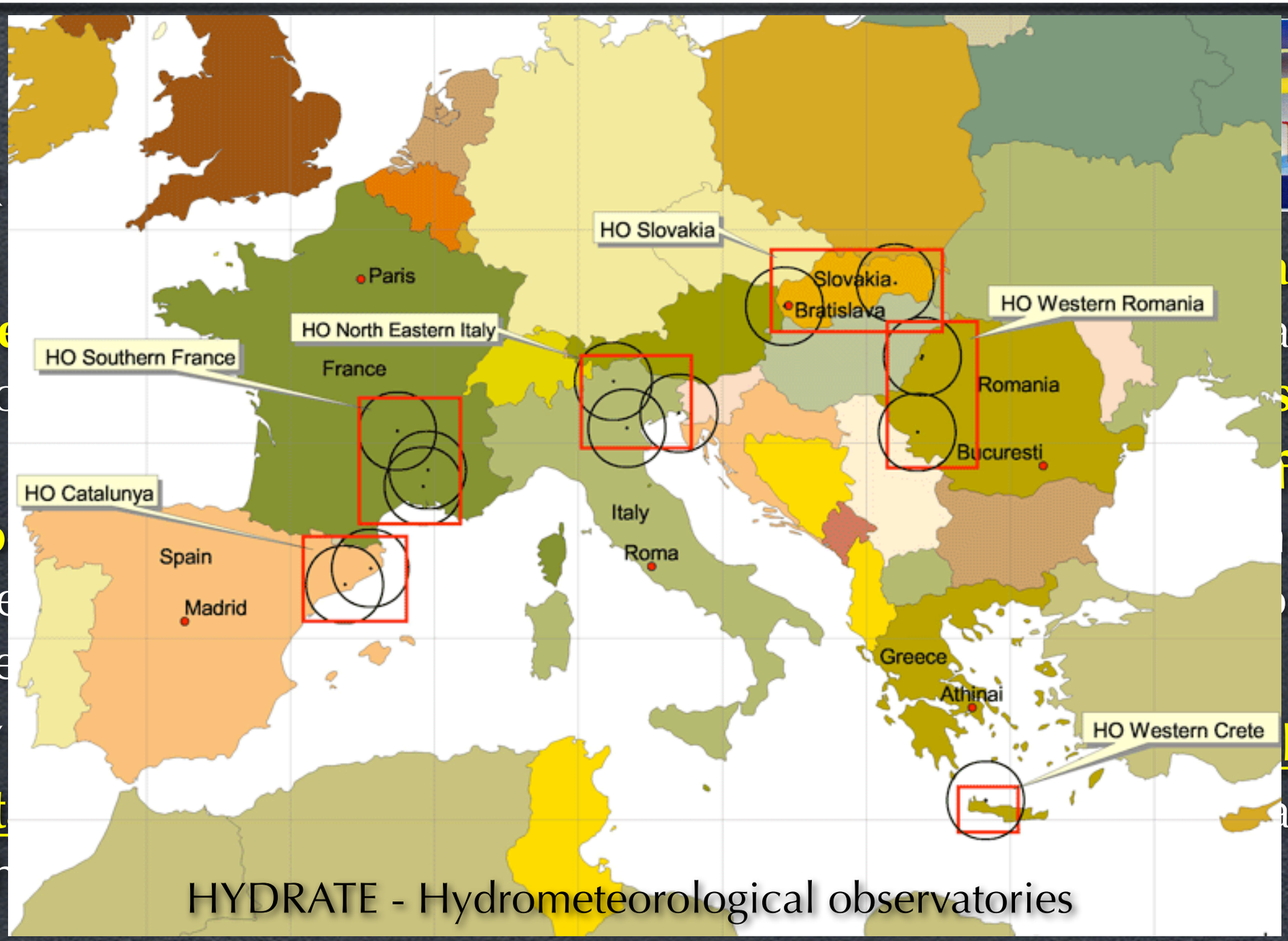

HYDRATE - Hydrometeorological observatories

Reseach Projects and Partnerships

Range

Catalunya

Spain

EU

EWASE (2006-2008)

Effectiveness and Efficiency of Early Warning Systems for Flash Floods

EWASE
Early Warning Systems Efficiency

- The EWASE project is embedded in the **ERA-NET CRUE** integrated project the 6th EU Framework Program (**FP6**)
- The Project Team comprises **3 universities and 2 engineering companies**.
- Main objective of EWASE is to develop a methodology for the **evaluation** of **Early Warning Systems' effectiveness and efficiency**.
- For the evaluation two basic factors will be compared: the **reliability** of the provided forecasts as a function of lead time and the **economic benefit** of this information.
- An inter-comparison between 3 hydrologic models in 2 different test basins (**Catalunya** and Austria) will **assess the uncertainties (using ensamble techniques)** in the provided flow forecast.

Catalunya in GPM GV

Thank you for your attention!

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meteo.cat

Agència Catalana de l'Aigua

Membre de:

IT XARXA DE CENTRES DE SUPORT A LA INNOVACIÓ TECNOLÒGICA

CIDEM

Amb l'acreditació de:

Generalitat de Catalunya
CIDEM

GRAHI

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Grup de Recerca Aplicada en Hidrometeorologia
UNIVERSITAT POLITÈCNICA DE CATALUNYA